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CELEBRATION
OF THE
ONE HUNDREDTH ANNIVERSARY
OF THE
FOUNDING OF THE ACADEMY.

MARCH 19.

The President, the HON. SAMUEL GIBSON DIXON, M.D., LL.D., in the Chair.

Three hundred and eighty-two persons present, including delegates from American and foreign corresponding societies and institutions.

The President introduced the HON. RUDOLPH BLANKENBURG, the Mayor of Philadelphia, who welcomed the delegates and guests to the city.

After brief instructions from the Recording Secretary, the delegates responded to the names of the societies and institutions represented by them as they were called by the Corresponding Secretary, their letters and addresses being handed to the President.

After announcements by the Recording Secretary, the President read an Historical Address.[1]

The routine of a stated meeting was then proceeded with in the belief, as was explained by the President, that an illustration of the formula by means of which the Academy had transacted its business as a society for one hundred years would be of interest to those familiar with the results which made the present celebration worth while.

The minutes of the last meeting and the minute of the first Recording Secretary, Dr. Camillus Macmahon Mann, dated March 21, 1812, defining the foundation, were read.

Additions to the museum and library were announced.

The Corresponding Secretary reported on letters received in connection with the centenary and others.

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[1] The Mayor's Welcome, the President's Address, and other contributions to the sessions will be published in the quartc Commemorative Volume (the fifteenth of the JOURNAL).

The Chair announced, with appreciative remarks, the death this morning of Thomas Harrison Montgomery, Jr., Ph.D.

The report of the Council was received.

The Publication Committee, acting in conjunction with the Centenary Sub-committee on Printing and Publication, reported that arrangements had been made for the publication of a Commemorative quarto volume (the fifteenth of the JOURNAL), an index to the entire series of the PROCEEDINGS and JOURNAL to the end of 1910, and a detailed history of the Academy by the Recording Secretary, of which the *Short History* published in connection with the *Philadelphia Founders' Week Celebration* may be considered a prodromus.

Papers under the following titles had been presented for publication since the last meeting of the Academy:

"Notes on a collection of fossils from Wilmington, North Carolina," by Amos P. Brown and H. A. Pilsbry (February 29).

"A synopsis of the genus Mastacembelus," by G. A. Boulenger (March 1).

"The vegetation of the banana holes of Florida," by John W. Harshberger (March 1).

"On the rate of growth of stony corals," by Thomas Wayland Vaughan (March 12).

"The faunal divisions of eastern North America in relation to vegetation," by Spencer Trotter (March 12).

"The relation of smell, taste, and the common chemical sense in vertebrates," by George Howard Parker (March 18).

"On the supposed Tertiary antarctic continent," by Sir William Thiselton Dyer (March 18).

Under the head of "Verbal Communications," the Recording Secretary gave some reminiscences of the people with whom he had been associated in the Academy for the past fifty years,[2] his first record of accessions to the library being dated February 4, 1862.

New nominations for membership were read. The election of members was postponed until next month.

The rough minutes having been read and approved, the meeting adjourned until the next morning at 10 o'clock.

SECOND DAY, MARCH 20.

The meeting was called to order by the President at 10.05 A. M.

The following communications were made:

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[2] These notes, with many others of the same kind, will be found in Dr. Nolan's *History of the Academy*, to be published in connection with the Centenary Celebration.

EDWIN G. CONKLIN, PH.D.: "Experimental Studies in Nuclear and Cell Division." Illustrated.*

During several seasons extensive experiments were made on the segmenting eggs of *Crepidula plana*. These experiments include a study of the influence on nuclear and cell division of hypertonic and hypotonic sea water, of ether, alcohol, etc., of the lack of oxygen, of carbon dioxide, of the electric current, and of pressure and shaking. The following general conclusions may be drawn from this work:

1. Under the same treatment the effects on cell division may be extremely varied, owing, probably, to the different stages acted upon.

2. A dividing cell is much more easily disturbed or rendered abnormal than is a resting one; the mitotic figure in particular is very easily altered and most of the abnormalities observed arise from this source.

3. The earlier stages of cleavage are much more easily altered than are the later ones.

4. Certain general abnormalities occur after the most varied treatment, *e.g.*, the general result both of concentration and of dilution of sea water is to produce polyasters and to prevent the cleavage of the yolk.

5. On the whole, the results of the hypertonic solutions are the same whether they are produced by evaporation of the sea water or by addition of NaCl, MgCl, or KCl to sea water; in short, these salts exert no specific action on cell division.

6. The most general modification of the mitotic figure is the production of polyasters, multipolar spindles, and as a consequence, multiple nuclei. In many cases the cells are filled with asters and irregular mitotic figures during division, while in the resting stage they are filled with equally numerous resting centrosomes and nuclei.

7. The movements of the chromosomes are in many cases interrupted, so that they remain scattered along the spindle, while the cytoplasmic movements are frequently stopped or altered.

8. In some cases the achromatic portion of the nucleus is separated from the chromatic part, and the two may persist side by side during the resting stage of the cell; in the division stages the achromatic nuclei give rise to asters, the chromatic to chromosomes and both may divide indefinitely, giving rise to large numbers of chromatic and achromatic nuclei.

9. The most general modification of the division of the cell body is the suppression of the cleavage of the yolk; this occurs in practically all the experiments; at the same time the cleavage may proceed more or less regularly in the protoplasmic portion of the egg. In normal eggs the first and second cleavages divide the yolk into four equal cells (the macromeres) and from each of these three small cells (the micromeres) are budded off.

10. If the yolk remains undivided it gives rise in certain cases to three micromeres, which have the characteristics of those formed

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* An asterisk after the title of the paper indicates that it is published in the Commemorative Volume of the JOURNAL of the Academy (XV).

from each of the four macromeres of the normal egg. If the yolk has divided once so as to form two macromeres, each of these may give rise to three micromeres, having the characteristics of the three quartet cells of the normal egg. In short, the number of micromeres depends upon the number of macromeres: when there are four of these as in normal eggs, the micromeres are formed in three quartets; when there are two, they are formed in three pairs; when there is but one macromere, *i.e.*, when the yolk remains undivided, the micromeres are formed singly.

11. When eggs are subjected to pressure the third cleavage which normally gives rise to the first group of micromeres, may divide one or more of the macromeres equally, thus giving rise to five, six, seven or eight macromeres. If the pressure is removed from such eggs each macromere gives rise to three micromeres in a manner approximately normal; again showing that the number of micromeres which may come from a macromere is fixed, whatever the number of micromeres may be.

12. The results stated in the two preceding paragraphs show that the omission or the addition of cleavages does not alter the character or localization of the egg substances and that the latter, when unimpeded, determines the character of the cell division.

13. Isolated blastomeres undergo partial development, each giving rise only to the cells which it would form if still a part of the entire egg, but the general form is entire, *i.e.*, there is no open side.

14. A weak electric current leads to the solution and disappearance of the chromatin and may destroy spindle fibres and astral rays, thus stopping mitosis. It may also destroy the polarity of the cell and prevent the normal separation of protoplasm and yolk.

15. Abnormalities of mitosis may perpetuate themselves in subsequent divisions, even when the cause which first induced them is removed.

Carlotta J. Maury, Ph.D.: "A Contribution to the Paleontology of Trinidad." Illustrated by drawings and charts.*

A large number of basal Eocene species recently discovered in the vicinity of Trinidad Island are described.

These fossils have a very significant bearing on the problem of the origin of the Midwayan and Lignitic faunas of the Gulf and of certain species found also in lower Eocene formations of the Atlantic coast of the southeastern States.

The shells were discovered by Mr. Arthur C. Veatch while exploring a small island called Soldado Rock. This lies off the southwestern end of Trinidad, in the Gulf of Paria, near the Serpent's Mouth, and rises about 100 feet above the surrounding waters. On this rock Mr. Veatch found a succession of eight beds of which Nos. 2, 6 and 8 were fossiliferous. The collections made by Mr. Veatch were given to the writer for identification.

Bed No. 2 was found to contain a rich fauna of basal Eocene forms, among the forty-four species being the exceedingly characteristic

North American species of that horizon, *Venericardia planicosta, Latirus tortilis, Calyptraphorus velatus*, var. *compressus, Levifusus pagoda*, and *Turritella mortoni*. To add to the interest, mingled with these were the characteristic Brazilian species from the Pernambuco beds, *Callista mcgrathiana, Chione paraensis*, and *Cucullæa harttii*. These had been previously found only in the Brazilian beds, especially in those of the Maria Farinha, a rivulet near Pernambuco. Thus the age of the Maria Farinha beds which before were usually doubtfully referred to the Cretaceous, and that of the Soldado No. 2 bed was definitely established as equivalent to the Eocene of Midway, Alabama.

The Soldado fauna was rich and varied. The genera *Ostrea, Venericardia, Fusus*, and *Turritella* led as regards numbers of species.

By the discovery of *Venericardia planicosta* at Soldado, its already remarkable range is extended south as far as 10° N. Lat. Moreover, its Antillean centre of distribution, postulated by Dr. Dall in 1903, is now established by the facts. In the light of those facts, we can trace this species from northern South America to southern and western North America and to northern and southern Europe.

From the Pernambuco basin the *Cucullæa harttii* fauna travelled north as far as Soldado; for in the early Tertiary there was no Amazon to act as a barrier with its discharge of fresh water. As far as known, Soldado was the northern limit of the migration of this fauna.

The *Venericardia planicosta* fauna travelled from the Soldado to the Alabama basin. This wandering species also crossed the strait covering the future Isthmus and established colonies along the Pacific coast in California and Oregon. It is a curious fact that its descendants are living there to the present day, although elsewhere the group has been entirely blotted out.

From the Alabama basin the *Venericardia planicosta* fauna continues to advance in a northeasterly direction up the coast, the peninsula of Florida having not yet been raised to force a detour. The accompanying species settled down along the way, *Turritella mortoni* advancing as far as Maryland. Thence *Venericardia planicosta* continued its advance alone to the north and east, eventually reaching the shores of northern Europe, probably *via* a Greenland-Iceland shallow water route. Established in Europe, it spread in great force over Belgium, France, and northern Italy.

In Bed No. 8, Soldado Rock, one of the commonest species is *Ostrea thirsæ*, so characteristic of the Lignitic Eocene of Alabama. Hence this species indicates a later migration from South to North America.

In conclusion, we may list the following as species which have migrated northward from the Soldado region as a centre of development: *Ostrea crenulimarginata* Gabb, *O. pulaskensis* Harris, *O. thirsæ* Gabb, *Modiola* cf. *alabamensis* Aldrich, *Venericardia alticostata* Con., *V. planicosta* Lam., *Meretrix* cf. *nuttaliopsis* Heilprin, *Lyria wilcoxiana* Aldrich var. *aldrichiana* n. var., *Levifusus pagoda*

Heilprin, *Clavella hubbardanus* ? Harris, *Latirus tortilis* Whitfield, *Fusoficula juvenis* Whitfield, *Calyptraphorus velatus* var. *compressus* Aldr., *Turritella humerosa* var. *elicitatoides* n. var., *Turritella nerinexa* Harris, *Turritella mortoni* Conrad, *Mesalia pumila* var. *allentonensis* Aldr., *Calyptræa aperta* Sol., *Natica* cf. *semilunata* Lea var., *Dentalium microstria* Heilprin. The same place of origin is indicated for the genera *Rimella* and *Venerupis*. The latter genus is now extinct in the Atlantic.

Interesting and ancestral forms of other genera, as *Pholas* and *Pleurotoma*, were also found at Soldado.

The Soldado faunas thus demonstrate that the Eocene of the Gulf coast, just like its recent molluscan fauna, contained a large Antillean element and that the lower Tertiary North American faunas were made up in great measure of immigrants from the shores of northeastern South America.

WILLIAM J. HOLLAND, SC.D., LL.D.: "David Alter, the First Discoverer of Spectrum Analysis."

Dr. Holland called attention to the fact that five years before Kirchhoff, the celebrated German physicist, had announced the possibility of determining the various elements by Frauenhofer's lines in the spectrum, Dr. David Alter had published in the *American Journal of Science* the results of his observations upon the spectrum, showing the possibility of determining the presence through the spectrum of various metals and gases. Dr. Alter's communications had been extensively reproduced in foreign scientific journals at dates preceding the publication by Kirchhoff of his discovery.

Dr. Holland exhibited the prism made by Dr. Alter with which he had conducted his investigations.

JOHN W. HARSHBERGER, PH.D.: "The Vegetation of the Banana Holes of Florida."

The eastern coast of Florida south of the sand hills at Delray is characterized by extensive outcrops of limestone known as Miami oolite. The surface of this Miami oolite weathers into angular nodules of lime rock and by water solution is eaten into pot holes of greater or less depth known as banana holes. These reach to the water table beneath the surface and have been filled with sand and organic débris until a soil has been formed which supports a vegetation distinct from that of the adjacent pine land. The soil of these sinks, which vary greatly in diameter, is more retentive of moisture than the porous soil of the pine land, so that the vegetation of broad-leaved trees and associated herbs is essentially mesophytic, while that of the pine land is essentially xerophytic. Most of the banana holes contain standing water during a part of the year.

The occupancy of these pot holes by the migration of plants into them is purely fortuitous, but the survival of any species, carried there by wind, water, and birds, is conditioned solely by the amount of space, light, and edaphic relations. A very slight difference in the soil, drainage, depth below the general surface of the adjoining pine land, amount of soil or standing water, amount of light which penetrates through the close stand of surrounding pine trees, makes a difference in the vegetation that fills the different banana holes.

In all, twenty-three plants were found in seventeen different banana holes investigated in a region where they are common, namely, between Naranja and Princeton in South Florida. The following is a list of the species and their relative abundance: *Sabal palmetto* (12), *Anona glabra* (11), *Chrysobalanus pellocarpus* (8), *Sagittaria lancifolia* (8), *Myrica cerifera* (6), *Persea pubescens* (4), *Vitis munsoniana* (4), *Proserpinaca platycarpa* (4), *Cladium effusum* (4), *Ilex cassine* (3), *Cephalanthus occidentalis* (3), *Salix longipes* (3), *Phlebodium aureum* (2), *Isnardia natans* (2), *Polypodium polypodioides* (1), *Typha latifolia* (1), *Phragmites phragmites* (1), *Smilax laurifolia* (1), *Quercus virginiana* (1), *Metopium metopium* (1), *Morinda roioc* (1), *Conoclinum dichotomum* (1), *Willugbaeya scandens* (1). Of these species nine are trees; two, shrubs; three are lianes; several are epiphytes; four are rooting aquatics and two are submerged aquatics.

The origin of these banana holes and the character of the native vegetation with which they are filled suggest the origin and nature of the larger areas of deciduous subtropic and tropic forest trees known in the South as hammocks. As the banana holes exist in all sizes from those which are a meter in diameter to those which cover several hectares, no sharp distinction can be made between the vegetation of the larger banana holes and the smaller hammocks which occur in the same region. Presumably the hammocks have had a similar origin as the banana holes by starting in a shallow, basin-shaped hollow of the prevailing oolitic limestone. This hollow has filled gradually with leaf-mold and sand liberated by the solution of the surrounding lime rock of which sand is a constituent until a sandy loam soil is formed in which the tropic forest trees find suitable conditions for growth. Once the hammock vegetation has established itself, it becomes self-perpetuative and forms a climax forest, which becomes an exclusive type gradually encroaching upon the area of country occupied by the slash pine, *Pinus caribaea*, which with its associates forms an ancient and successful type of forest holding well its own against other competing types of vegetation.

FREDERICK W. TRUE, LL.D.: "A New Species of Delphinodon." Illustrated.*

Dr. Frederick W. True gave an account of a new species of fossil porpoise from the Miocene formation of Maryland, belonging to the genus *Delphinodon*, for which the name of *Delphinodon dividum* is proposed. The U. S. National Museum was engaged in 1908 and 1909 in making collections of cetacean remains from the Calvert Cliffs, Maryland, and obtained several skulls and fragments of skulls, many limb bones, and large numbers of vertebræ. In addition, the Museum obtained a nearly complete skeleton of a fossil porpoise belonging to the family Delphinidæ. This specimen comprises the skull and mandible, about thirty vertebræ, many pairs of ribs, a scapula, limb-bones, and numerous teeth, including several *in situ.* It is possible from this material to determine accurately the characters of the species. The skull is distinctly delphinoid, but the crowns of the posterior teeth, instead of being simple and conical, as in typical recent Delphinidæ, are trituberculate, with rugose enamel. The cervical vertebræ are all separate, the neural spines of the thoracic vertebræ erect, the transverse processes of the lumbar vertebræ long and slender, but not acuminate, and the ulna furnished with a lunate olecranon.

The new species appears to belong to the genus *Delphinodon,* which is based on two or three forms known only from detached teeth, and hitherto regarded as belonging to the Squalodontidæ. From the evidence furnished by the new material, the genus should probably be transferred to the Delphinidæ.

HENRY H. DONALDSON, PH.D.: "The History and Zoological Position of the Albino Rat."*

There are two common rats in the United States: *Mus rattus,* the black rat, together with *Mus rattus alexandrinus*—its gray variety—and *Mus norvegicus,* the common brown or Norway rat. *Mus rattus* entered Europe from the east about the thirteenth century and spread widely, reaching America on the ships of the early explorers and colonists. *Mus norvegicus,* also coming from the East, did not arrive in Europe until the beginning of the eighteenth century and in America not until 1750 or 1775. Wherever the Norway rat has gone it has displaced the *Mus rattus.* The common albino which we see to-day is a strain of the Norway rat. It seems probable that at one time albinos of *Mus rattus* must have existed, but they are nowhere to be found at present. The origin and history of the existing albinos is obscure, but there is no evidence that they have established themselves in open competition with the pigmented forms.

They are always found under conditions of domestication. This manner of life has led to some structural modifications, and especially noticeable is the diminution in the weight of the central nervous system.

Although all albinos breed true to color, yet their composition is not identical, as is shown by the fact that in crosses of extracted albinos with pigmented forms, the color markings of the progeny are modified according to the ancestry of the albino. A pure strain of albinos is therefore not obtainable.

EDWARD B. MEIGS, M.D., and L. A. RYAN, PH.D.: "The Ash of Smooth Muscle."[3]

The smooth muscle of the bull-frog's stomach has been analyzed quantitatively for potassium, sodium, iron, calcium, magnesium, phosphorus, chlorine, and sulphur by methods in general similar to those described by Katz in the *Archiv für die gesammte Physiologie*, 1896, Vol. LXIII, pp. 1 *et seq.* At least two determinations were made in the case of every element; and in no case, except that of sodium, did the parallel determinations differ from each other by more than 15 per cent. In the case of sodium, one determination was about 24 per cent. higher than the other. The following are the average amounts of the elements found, given as per cent. of the fresh tissue: Potassium, 0.3250; Sodium, 0.0726; Iron, 0.0007; Calcium, 0.0042; Magnesium, 0.0129; Phosphorus, 0.1372; Chlorine, 0.1195; Sulphur, 0.1612. Six determinations were made of the water and total solids. The averages were solids, 17.70 per cent.; water, 82.30 per cent. The widest differences were solids I, 17.39 per cent.; solids VI, 17.99 per cent.

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[3] The entire article in *The Journal of Biological Chemistry,* May, 1912.

Parallel analyses of the ash of the striated muscle of the same frogs were made, and the results obtained were quite close to those reported by Katz for frog's striated muscle. The work indicates that smooth muscle contains somewhat less potassium and phosphorus and considerably more sodium and chlorine than striated muscle, but the differences are much less marked than has sometimes been supposed.

The chemical work was supplemented with microscopic study of fixed and fresh samples of the tissue analyzed as "smooth muscle," and it was found that about 80 per cent. of its volume was smooth muscle fibre; about 5 per cent. extraneous connective tissue; and the remainder, interstitial spaces between the muscle fibres.

MARSHALL A. HOWE, PH.D.: "Reef-building and Land-forming Seaweeds." Beautifully illustrated.

That the corals and other lime-secreting animals are active agents in building reefs and forming land has been a matter of common knowledge and belief for more than half a century, but that certain marine algæ or seaweeds also have an important and sometimes predominating part in the same great work has received no particular emphasis until quite recent years. Most people think of sea plants, if they think of them at all, as small delicate ornamental "sea-mosses" or as coarse, succulent, not especially attractive, kelps or rockweeds, having in either case, little solid substance to be left behind on their decay. The fact is, however, that there are many different kinds of marine plants that secrete lime from the sea water and are more or less hard and stone-like, so that their decay or their continued upward growth is accompanied by a considerable increase in the height of the sea bottom wherever these plants happen to be growing. The corals are, generally speaking, confined to the warmer seas, but the corallines, lime-secreting marine plants with a superficial resemblance to the corals, are more widely distributed, having, in fact, been found to be very abundant more than 12° north of the Arctic Circle. The late Professor Kjellman, of Upsala, has stated that off the shores of Spitzbergen and Nova Zembla a certain coral-line (*Lithothamnium glaciale*) forms thick layers on the ocean floor, mostly in 60 to 120 feet of water and that "in the formation of the future strata of the earth's crust in these regions it must become of essential importance." Dr. Henry B. Bigelow, of Harvard University, was quoted as stating that "algæ probably form the greatest mass" of the "shell sands" of Bermuda, and Sir John Murray, in reporting the results of the famous Challenger Expedition, has recorded his opinion that in three out of four analyzed samples of so-called coral sand or mud from Bermuda the calcareous seaweeds and their broken-down parts composed over 50 per cent. of the mass. As Dr. Bigelow has remarked, the reports of the borings in Funafuti, a "true coral" island of the Ellice group, recently published by the Royal Society of London, are of special interest in this connection. Borings were here made to a depth of over 1,100 feet and the materials brought up indicate that the lime-secreting seaweeds have been of greater importance then the corals in the formation of this island.

The lecture was illustrated by about forty lantern-slides, showing various types of calcareous seaweeds, and also by specimens from the speaker's collections in the West Indies and elsewhere.

Adjournment for luncheon.

The meeting reconvened at 2.40 P.M., when the following communications were made:

BENJAMIN SMITH LYMAN: "Natural History Morality."

Our predecessors, in founding the Academy, a hundred years ago, probably little dreamed of any direct association of morality with the study of natural history. They had doubtless been attracted to the study by the beauty of its objects, as well, perhaps, as by an instinctive feeling that a more thorough knowledge of them might lead, not only to various commercial benefit, but to intellectual broadening and improvement in many ways. Naturally, the first thing to be done was to collect the facts, to describe and distinguish by names the countless varieties of animals and plants; and then to arrange them in systematic order. Whether the expression "natural sciences" in the Academy's name was merely intended to cover natural history or not, it certainly has turned out that, for a hundred years, that has been almost exclusively the Academy's field of work. Only through occasional strict construction and a literal, logical interpretation of the society's name have astronomy, chemistry, and other branches of physics been able, from time to time, to assert and maintain a scanty foothold in the Academy's proceedings. Through almost the whole of the first half of the century, the natural history work was patiently, zealously, creditably, and interestingly occupied with collecting, describing, naming and systematizing the natural forms that could be found in near and distant parts of the world. Since then, Darwin's great discovery of the origin of species through natural selection, so sympathetically appreciated at once by our Academy, has immensely enlarged the scope and interest of the study, making it plain that all living species, including man himself, have originated one from another; so that all are but genetically consanguineous parts of one great whole, and the study of one part is, therefore, more distinctly and surely a guide to the complete understanding of the other so related, and thereby more or less similar, parts. From a full consideration of this relationship may be deduced the strongest possible incentive to morality and the clearest guide to its correct principles.

We may perceive that natural history studies teach us that what is aimed at is not the benefit and survival of each and every individual, but the perpetuation and progress of the race, through the success of its most vigorous, ablest, fittest, members. For, in fact, not only are species derived from one another, so as to be but parts of one whole; but a race is yet more closely a unit, the somewhat varied outgrowth of a single progenitor, as the leaves and limbs of a tree grow out from one stem; though, in some cases, detached, to be sure, like the rooted limbs of a banyan tree separated from the perhaps perished parent trunk, or the rooted runners of a strawberry-plant, or of a walking-fern, or of any layered plant. The propagation by artificial grafting of a bud, or scion, on a kindred stock is closely parallel, with some variation in character from the new stock. The perpetuation by a seed, a specialized portion of the tree, with the whole character of the tree concentrated in small compass, as fully as in a bud or scion, and naturally detachable and capable of growing in a favorable soil and temperature, is plainly no less an outgrowth, a growing forward, of the parent tree, than is the growth of a rooted limb, or runner, or a grafted bud or scion. In the case of animals, the simplest forms, like the amœba, merely divide in halves, and each half grows forward, with equal claim to be the identical parent stock; but, in more complex organisms, minute specialized portions only of two parents, with the character of these parents concentrated therein (as a plant's is in its seed), unite and grow, when favorably situated, partaking of both characters, as a scion grafted on a rooted stock is doubly affected. The race, then, is the perpetuated individual, and all parts of the race are, in some sort, one, identical, with its progenitor; and as all races and species have been derived from one another, the oneness, or identity, extends to all living beings.

Surely, this identity is the highest incentive, as well as the best guide, to morality. In the first place, it is seen that the true object of morality is the benefit of the race, rather than of the individual; though, of course, the individuals partake of the benefit. This view makes the individual willing to die, if need be, for the true benefit of his race. The appropriate instinct established by natural selection makes the mother, whether human or brute, fight with the utmost courage or most ingenious cunning for the preservation of her young, as, indeed, for her own perpetuation, for the life of what has been a part of her own body, and is still no less a part of her, notwithstanding its being detached.

Here, too, is the root of the more kindly features of the morality taught by natural history, that fully counterbalance what may often be thought the dominant and essential, but harsher, characteristics of the instinctively selfish, sometimes fierce, struggle for existence under natural selection, wholly incapable, it may seem, of any connection with the gentle moral rules of conduct for men's intercourse with men, which are now generally supposed to require mild self-abnegation. To some degree among many of the lower animals, but still much more in the human race, the weak and defenceless young need for a time the protection and aid of the parents. Any portion of the race that should have been deficient in the instinct that provides such help would obviously have died out; so that the instinct has become universal. This instinct, not only unites in friendliness the parent and child, but tends to soften the character of both, even with regard to outsiders, and makes possible and probable more or less friendly intercourse between brethren, and, by a sort of natural infection, between less closely related men; and it is this feeling that has been at the bottom of all systems of morality.

The aim, in general, is not to favor one individual only, but to give all an equal chance, to establish justice, in order to enable the ablest, the fittest, to survive and perpetuate the race in the highest vigor and best condition; while the weaklings and those possessed of characters prejudicial to the healthful permanence of the race shall tend to die out and disappear. Clearly, the success of the race depends on the success of the fittest individuals in this struggle for existence and justice. "A mush of concession," in which the individual always yields everything, with a total eradication of seeking for selfish advantage, would be as harmful to the prosperity and eventual survival of the race, as would be an over-grasping selfishness that would deny what is fair to every competitor. The race can only progress through the benefit to individuals. Selfishness, then, the desire for private gain, is not altogether wrong, but should be enlightened, should avoid running to excess, by conceding, not only justice, but (to insure against the possible exaggeration of one's own ideas of what might be rightfully claimed) should yield something more than what, to the claimant, seems mere justice; that is, should aim at nothing more than justice seasoned with kindness. This, then, is the practical rule that natural history indicates for the guidance of intercourse between men; and enforces it unswervingly, impartially, and inexorably by the most effectual penalties for any transgression, even to the shortening of life, or to the wretchedness of a later generation, or the extermination of a family or tribe, with as much certainty as the punishment for the violation of hygienic laws.

The incentive to high morality is particularly obvious to anyone who realizes that his child is but an outgrowth from himself, that it is, in fact, a part of himself. For he would perceive how important it is that in this new life he should inherit the best possible characteristics from both himself and the child's mother, and should, thereby, be able to start forward on his new career under the most favorable physical and moral circumstances. The idea greatly reënforces the natural instinct, sometimes dulled, or even wholly perverted, towards family life, which has long been considered the chief promoter, if not the very foundation, of morality.

Evidently, natural history supplies the clearest principles and most cogent motives for morality; and further and more precise knowledge of the instinct of animals in their natural state (not so much in the artificial, pampered, domesticated condition) may sometimes yield important guidance towards detailed rules of conduct. Special applications of the principles (not according to mere speculations, but to observed facts) are to be worked out, also, by courts of justice, aided by schools, colleges and learned societies, as the tendency has been for hundreds of years, especially among the more logical nations.

Natural history, then, teaches through the thorough unity and consanguinity of all living things, that, besides sympathizing with them all and perceiving how much may be advantageously learned from them as our relatives and congeners, we must not merely struggle with them and with each other for existence and the survival of the fittest, to the benefit of the race, but for the same reason, equally must aid in the protection of our weak immature ones, strictly our second selves, and by this habit, or instinct, maintain complete morality, under the strongest incentives, unerringly and inflexibly guided by natural selection.

JACQUES LOEB, M.D., PH.D., SC.D.: "Experiments on Adaptation to High Temperatures." (No abstract.)

HENRY SKINNER, M.D., SC.D.: "Mimicry in Butterflies."*

It has been stated that some of the females of the American species of *Papilio* have gradually changed their appearance to resemble *Papilio philenor*, a species which in the larval stage feeds on *Aristolochia serpentaria*, a plant having a root poisonous to man. It is therefore contended that in the imago stage this butterfly is nauseous or poisonous to birds, and that the birds, mistaking the edible species for *philenor*, avoid them.

The objections to this hypothesis are, that the records of birds eating butterflies are very meagre, and there is no evidence to prove that *philenor* is nauseous or poisonous to birds.

It has been shown that plants may be poisonous to man, to some other animals, and yet may be eaten by birds with impunity.

The species said to be protected by their resemblance to *Papilio philenor* are different in appearance in the two sexes and it is the females that show this mimicry. These sexual differences are termed antigeny and it is not unusual in the butterflies. It is due to some general law and not in certain instances to so-called mimicry.

The evidence advanced to prove mimicry in the Papilios was considered inconclusive. Other cases of so-called mimicry in the butterflies were regarded as being brought about by environmental conditions, such as vertical distribution and desert distribution.

SPENCER TROTTER, M.D.: "The Faunal Divisions of Eastern North America in Relation to Vegetation."*

Vegetation is more directly concerned in the problem of faunal distribution than are the factors of heat and moisture. These, of course, control vegetation, but soil is a more important control factor. Topography likewise exerts a considerable influence. Zonal arrangement of faunas is unnatural. On this basis of the vegetation control, the following outline of Faunal Areas is submitted as best expressing the known facts:

I. THE SUB-ARCTIC FAUNA.
(a) Barren Ground Type.
(b) Tree-limit Type.
II. THE ATLANTIC FOREST FAUNA.
(a) Coniferous Forest Type.
(b) Deciduous Forest Type.
III. THE COASTAL PLAIN FAUNA.
(a) The Alluvial Forest Type.
(b) The Marshland Type.
(c) The Pine Barren Type.
IV. THE GRASSLAND FAUNA.
(a) The Prairie Type.
(b) The Steppe Type.
V. THE PLATEAU FAUNA.
(a) The Cactus Desert Type.
(b) The Mountain Forest Type.

T. WAYLAND VAUGHAN, PH.D.: "Rate of Growth of Stony Corals." Illustrated. (No abstract.)

HENRY A. PILSBRY, PH.D.: "On the Tropical Element in the Molluscan Fauna of Florida."*

A sketch of the successive non-marine faunas of the region was given and the genesis of the several elements composing the molluscan fauna was traced. A Mexican group of forms was recognized and evidence was adduced to show that they entered southern Florida at the close of Miocene or very early in Pliocene time. Antillean species were held to be of later advent in Florida. The probability that they had been carried from Cuba by hurricanes was discussed. The various points were illustrated by lantern slides of shells and maps.

The session closed with a beautifully illustrated communication on "The Photography of Wild Birds," by WILLIAM L. BAILY. (No abstract.)

Adjournment until the following morning.

A brilliant invitation reception was given in the evening by Dr. Dixon, Mrs. Dixon, and Miss Dixon in the Bellevue-Stratford Hotel from 8 until 11 o'clock.

THIRD DAY, MARCH 21.

The meeting was called to order by the President at 10.30 A.M.

The Chair referred to the fact that the late Dr. Montgomery had been placed on the program for the first paper of the session under the title "Human Spermatogenesis: Spermatocytes and Spermiogenesis," but his funeral would take place to-morrow at 10.30 A.M.

EDWIN J. HOUSTON, PH.D., then made a communication on "How the Natural Sciences can be made Attractive to the Young."

If the natural sciences fail to interest the young, the fault is due neither to the character of the subject nor the age of those whom we wish to instruct, but to some faulty or illogical method of presentation. The collections of the Academy present a fine opportunity to interest the young in the natural sciences and they are doing this now, but more could be done. The Academy encouraged and assisted such men as Leidy, Cope, Morton, Rand, Tryon, Ryder, Cassin, Parker, and many more, but it may have failed to develop others.

It is one thing to read about a natural object and another to examine a carefully prepared specimen of it, still better to know it by actually touching and handling it. The young should be encouraged to make collections for themselves. In order to insure the best results, the aid of a teacher will be required. Lectures specially arranged are a great help, and means should be taken to encourage exchange, an endeavor being made to promote what may be called chumminess among the collectors. Interest will soon die if the young investigator has no companion.

Suitable books are essential. They are not numerous. The average books on the natural sciences cannot be used by children. Dr. Houston had prepared a series of books, keeping in mind the unwillingness of the child to read anything that looks like a schoolbook. He had adopted the style of the Jules Verne stories and endeavored to improve on it, making the work interesting while being scrupulously careful to sacrifice no scientific truth. The plan of these books was described in detail.

The following communications were also made:

JAMES A. G. REHN: "The Orthopteran Inhabitants of the Sonoran Creosote Bush, Covillea tridentata."

The species of Orthoptera known to occur only on this bush were shown to be six in number, representing three families and five genera of the order. The remarkable color resemblance of certain of the forms to portions of the plant was discussed and the distribution of the species within the range of *Covillea* stated. Certain other species of the order very commonly found on the same shrub were also mentioned. Specimens of the host plant of all the peculiar species and a map of the distribution of the creosote bush were exhibited.

HENRY FAIRFIELD OSBORN, D.Sc., LL.D.: "Tetraplasy, a Law of the Four Inseparable Factors of Evolution."*

Upwards of twelve years of work on the group of fossil mammals first made known by Joseph Leidy, which may now be known popularly as the Titanotheres, had led to the conviction that vertebrate palæontology may concern itself with two great questions in evolution:

(1) The origin of new characters.
(2) The transformation of existing characters.

Excluding any external agencies, we must seek such *origins* and *transformations* either in:

(1) Environment, physical or biotic.
(2) Ontogeny, that is, in the development of the body, or soma.
(3) Heredity, or in the development of the germ.
(4) Selection, or in the competition between organisms.

Having reached in 1905 the conclusion that our quest for the origin and transformation of characters must be directed to one or the other of these four factors, working individually or separately, the author published in 1908 what he believes to be the most fundamental biological law, and termed it *The Law of the Four Inseparable Factors.*[4]

In nature each of these factors is in a sense independent, with its peculiar or intrinsic phenomena; in another sense dependent, or intimately related to each of the other factors.

It is a striking fact in the history of biology, from the middle of the 18th century, that the particular factor upon which naturalists have concentrated their attention has seemed to them the all-important or all-sufficient factor. Thus Environment in the minds of Buffon, or Semper, or Wagner appeared to be the efficient cause of evolution. Similarly, Ontogeny in the minds of Lamarck, Spencer, Cope, seemed to be the primary source of evolutionary change. Again, Selection in the minds of Darwin and Wallace, combined with hereditary fortuitous variation, seemed to possess the chief constructive power in evolution. Finally, as the latest phase, Heredity, as developed by Galton, Weismann, Mendel, De Vries, and Bateson, has come to be regarded as the chief centre of transformation.

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[4] "The Four Inseparable Factors of Evolution, Theory of their Distinct and Combined Action in the Transformation of the Titanotheres, an Extinct Family of Hoofed Animals in the Order Perissodactyla." *Science*, N. S., Vol. XXVII, No. 682, Jan. 24, 1908, pp. 148–150.

The interoperation of the four factors may be represented symbolically by the letters E. O. H. S.

Returning to our original questions as to: (1) the origin and (2) the transformation of characters, we first observe that there is the following general relation:

External	Initiation	Environment, E.
Internal	Genesis	Ontogeny, O.
"	"	Heredity, H.
External	Fixation	Selection, S.

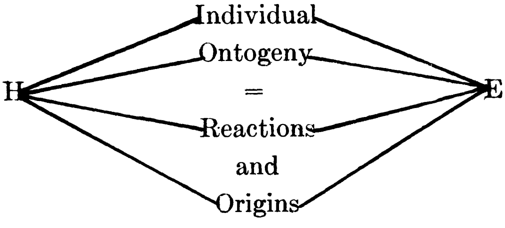
All phenomena involving either the origins or the transformations of character may be conveniently represented by the use of formula composed of E, O, H, S. Similarly, all interpretations of changes of character should be made with this interoperation of the factors in mind. For example, in the matter of continuity or discontinuity, we find that E, O, H, S, must all be considered. Thus the "continuity in Heredity" of the germ plasm is no more vital than the "continuity in Ontogeny," or "continuity in Environment," or "continuity in Selection," because change or discontinuity in any one of these three latter factors, E, O, S, immediately or finally results in transformation of character in H.

Again, in experimental as contrasted with natural conditions we observe the following:

In experiment,
  Selection may be removed or altered.
  Environment may be altered.
  Ontogeny may be altered.
  Heredity may be affected through E, O, S.
On the contrary, in nature,
  E, O, H, S, are constantly interoperative.

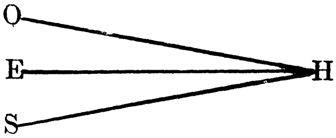
Thus the tetraplasic law, first conceived in 1905, first expressed in 1908, may now be expressed in 1912 as follows: *The life and evolution of organisms continuously centre around the processes which we term Heredity, Ontogeny, Environment, and Selection; these have been inseparable and interacting from the beginning; a change introduced or initiated through any one of these factors finally results in a genetic change.*

The conception of the individual, therefore, may be expressed in the following diagram A:



That is, the Ontogeny of the individual springs from its Heredity, with its incessant reactions and origins, in response to its Environment.

Similarly, Heredity is sooner or later in the history of a phylum under the influence of the three factors, Ontogeny, Environment, Selection, as represented in diagram B.



This conception of the continuous interoperation of the four factors in no way diminishes Heredity as the final seat of all genetic change; either from the first or as a sequel to a long series of antecedent interoperations, the seat of the *origins* and of the *transformations* of characters is certainly in Heredity.

Thus so far as the present law is concerned, the problem of evolution is to determine the relation between the interoperation of the four factors E, O, H, S, and the final fixation of the results of this operation in Heredity.

Merkel H. Jacobs, Ph.D.: "Physiological Characters of Species."

In the experiments, on which the paper was based, an attempt was made to compare a number of organisms with regard to certain of their physiological characters. The organisms selected were twelve species of protozoa, viz., *Paramecium caudatum*, *P. aurelia*, *P. bursaria*, *Colpidium colpoda*, *Coleps hirtus*, *Blepharisma lateritia*, *Euplotes patella*, *Vorticella nebulifera*, *Peranema trichophorum*, *Euglena viridis*, *Chilomonas paramecium*, and *Entosiphon sulcatum*. The character chiefly studied was the effect of carbon dioxide on the movements and the general vitality of these forms.

The experiments showed that each of the species in question reacts to carbon dioxide in a characteristic manner and that each has a general resistance to its toxic effects, which while varying to some extent with different individuals and in different cultures, is nevertheless fairly constant for the species. The most sensitive form studied was found to be *Coleps hirtus*, which is killed, as a rule, in three or four minutes, while *Colpidium colpoda*, the most resistant form, under exactly the same conditions, remains uninjured after many hours. Some forms were killed outright very quickly, while others, although losing all power of movement within a few moments, yet retained for a long time the ability to recover when again restored to normal conditions.

One of the most striking results obtained was the demonstration of the difference in the effects of carbon dioxide on different elements within same cell. In general, contractile structures (myonemes) are paralyzed within a few seconds, while vibratile structures (cilia, membranelles, flagella) are affected only after a much longer time. In *Vorticella*, for example, the power of contraction is lost in less than a minute, while the membranelles may beat normally for three-quarters of an hour or longer. Sometimes a converse relation in the effect of carbon dioxide on these two classes of structures appears, the contractile elements being first stimulated and then paralyzed and the vibratile ones often temporarily stopped and then started again.

George Howard Parker, Sc.D.: "Sensory Appropriation, as illustrated by the Organs of Taste in Vertebrates."*

In addition to smell and taste, ordinarily regarded as chemical senses, vertebrates possess a third sense which may be called the common chemical sense and which is exemplified in man in the sensitiveness of the mucous surfaces of the eye, nose, etc. Contrary to the opinion of Weber, solutions of odorous substances introduced into the human nose can be smelled. Hence Nagel's contention that the nose of the water-inhabiting vertebrates is an organ of taste rather than an organ of smell is unfounded and the recent work of Parker and of Sheldon has shown conclusively that fishes scent their food with the nose as air-inhabiting vertebrates do, *i.e.*, the nose in vertebrates, water-inhabiting as well as air-inhabiting, is a distance receptor. A comparison of the chemical responses of catfishes, with and without organs of taste, shows that the common chemical sense is more closely related to the sense of taste than to the sense of smell and that its receptors are the free-nerve terminations of certain fibres in the spinal and cranial nerves. Of the three senses, smell, taste, and the common chemical sense, the most primitive is the sense of smell, which probably represents the specialized and restricted remains of a general chemical sense common to the whole surface of the invertebrate ancestor of the vertebrates. By a central migration of the cell body of these primitive olfactory receptors of the general surface, the organs of the common chemical sense were produced. These in turn appropriated groups of epidermal cells which in time became specialized into taste buds, and thus arose the third and last of these chemical sense organs, the organs of taste.

John M. Macfarlane, Ph.D.: "The Relation of Protoplasm to its Environment."*

The simplest plants now living are the Schizophyceæ and the Schizomycetes, both composed of cells or cell chains with rich granular protoplasm, with or without a chromatophore, and either devoid of a nucleus or with a granular chromatin rudiment of it.

The species of the two groups now found in hot springs at temperatures of 55°–75° C. are probably primitive types, alike on account of their wide distribution over the world and their adaptation to high temperatures. From these, there seem to have developed forms that became acclimatized to cooler conditions, though the thermophilic bacteria of soils, manure heaps, etc., still grow and multiply at a high temperature and may be direct descendants of hot spring species.

The spores and even at times the mature plants of some fungi, mosses, ferns and selaginellas can resist prolonged exposure to 55°–70° C. without injury, while 100° C. may not destroy the vitality of the spores. Experiment has equally shown that spores, or cells, of some of the above can be exposed to from 75° C. to —150° C. without loss of germinating capacity. Amongst flowering plants, seeds have been exposed to from —75° C. down to —200° C. without injury, while many species of tropical desert regions and of sub-arctic or arctic regions show a range of temperature resistance from 75° C. down to —65° C. An abundant protoplasm and stored food, enclosed by thick mucilaginous or cuticular walls that can act as regulators to environal changes, are all-important cell factors in ensuring continued protoplasmic existence. The relative water content of the cell, and the composition of the protein substances that are included, are probably the main factors in limiting protoplasmic resistance.

WILLIAM H. DALL, A.M., Sc.D.: Mollusk-fauna of Northwest America.* (No abstract.)

The meeting adjourned at 1 P.M. for luncheon, and was called to order again by the President at 2.20 P.M.

HENRY G. BRYANT: "Government Agencies in the Advancement of Geographical Knowledge in the United States." Illustrated by maps and charts.

Attention was drawn to the importance of agencies such as the U. S. Coast and Geodetic Survey and the Geological Survey in advancing geographical knowledge. While the picturesque aspect of the subject represented by expeditions of exploration has received attention, the quiet work of these organized forces of the government is little known to the general public. In early days, the Federal Government sent Lewis and Clark, Pike and Fremont to investigate the western country. The work of these men and the discovery of gold in California resulted in bringing about a fair knowledge of the main physical features of the country by the middle of the nineteenth century.

The Coast Survey is the oldest bureau of applied science, and for nearly a century has been engaged in surveying the coasts of the United States. Its officials, co-operating with those of Canada, are surveying the Alaska boundary, where conditions of unusual hardship are encountered. The operations of this bureau have included: A survey of the coast, deep-sea soundings, study of the tides and of the Gulf Stream, and of terrestrial magnetism.

Following the close of the Civil War and the rush of settlers to the West, there came an imperative demand for a better knowledge of the western country, which resulted in the organization of the U. S. Geological Survey in 1879. The geographical work of the Survey—as illustrated by excellent topographical maps on various scales, and our contribution to the great International Map of the World—was referred to.

The availability of all this material at a nominal cost has done much to advance geographical knowledge. Other official agencies which assisted were: The General Land Office, which issues numerous maps; the Hydrographic Office of the Navy Department, which publishes charts of foreign coasts and harbors, and the Map Collection of the Library of Congress at Washington, which was described as the largest in this country.

Witmer Stone, A.M.: "Fauna and Flora of the New Jersey Pine Barrens." Illustrated by beautiful lantern pictures.

Leisure time during the past fifteen years had been occupied in collecting data upon the distribution of animal and plant life in the coastal plain of New Jersey. There was a marked difference in the fauna and flora of western and central New Jersey south of the fall line, as compared with the Pine Barren area, and east of the latter there existed a narrow strip bordering the maritime marshes and recurring on the coast island, which possessed the same type of plant and animal life as characterized west Jersey. The Cape May peninsula belonged also mainly to this region, the Pine Barren elements being only local.

The historic associations of the Pine Barrens were considered, and the plants discovered there by Bartram, Pursh, Rafinesque and Nuttall were enumerated. In considering the change of conditions in the region, stress was laid upon the constant increase in the extent of cultivated cranberry bogs and the injurious effect of the winter flooding upon various rare plants which inhabit the native bogs. *Abama americana,* and *Tofieldia racemosa* were two species which were seriously threatened in this way. Mr. Gifford Pinchot's theory in regard to the origin of the stunted forest of the elevated region known as the plains was endorsed. No difference could be detected in the character of the soil of this region and other parts of the Pine Barrens except in the greater coarseness of the sand and gravel, and repeated forest fires seemed to have kept down the tree growth when once the stunted condition had been produced.

Numerous lantern slides illustrating the scenery and characteristic birds and plants were exhibited showing the transition experienced in crossing the coastal plain from Philadelphia to the coast.

In the evening one hundred and sixty members, delegates, and guests partook of an enjoyable banquet in the remodelled library hall. Dr. Conklin acted as toastmaster and responses were made by His Honor the Mayor; Mons. de Pulligny, the Director of the French Commission of Engineers to the United States; Dr. Henry Fairfield Osborn, of the American Museum of Natural History; the President of the Academy; Dr. Theodore Gill, of the United States National Museum; Dr. William J. Holland, of the Carnegie Museum, Pittsburg; and Dr. Nolan. The celebration of the one hundredth birthday of the Academy terminated with the singing of *Auld Lang Syne.*

The following were ordered to be published: